OBITUARY NOTICES

OF

FELLOWS DECEASED.

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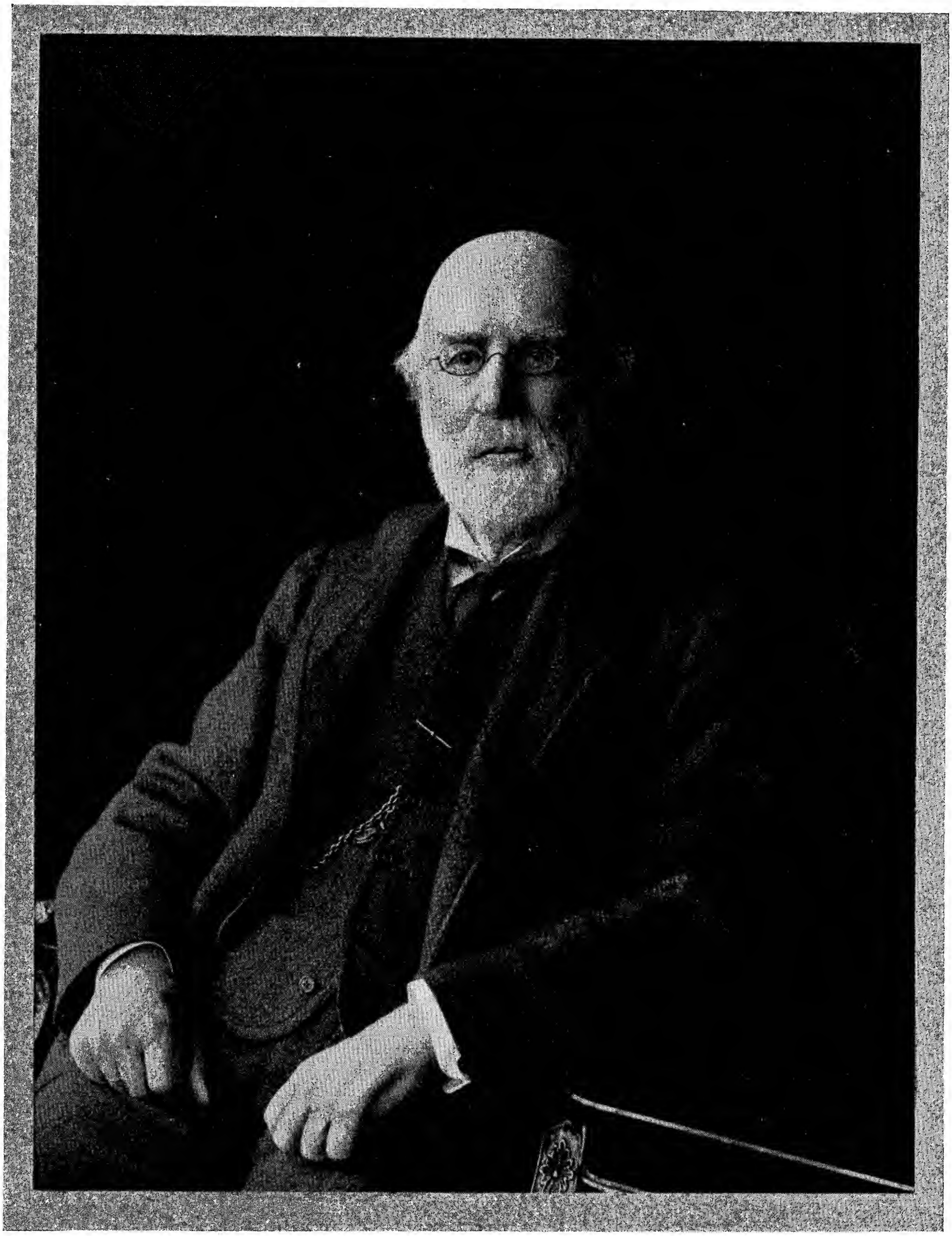


Ducie

EARL OF DUCIE, 1827–1921.

The late Earl of Ducie, who died at his seat, Tortworth, Gloucestershire, was born on June 25, 1827, and was the "father" of the House of Lords, which he entered on the death of his father in 1853. He was also the "father" of the Royal Society, to which he was elected in 1855, as well as the oldest Lord Lieutenant in England, having been appointed by Palmerston in 1857.

He was the eldest of ten brothers and four sisters, several of whom survive him, but his only son, Lord Moreton, died in 1920, leaving no heir, so that he is succeeded by his brother, the Honourable Berkeley Moreton, formerly Colonial Secretary for Queensland, where he has resided for many years.

Lord Ducie was a type of man more common perhaps in the early Victorian era, to which he belonged, than at present, who received the honour of our Fellowship rather on account of his position and his general interest in Science, than for any special study or work that he had done.

If, however, Arboriculture is a science, and a tree-planter has a claim to be elected an F.R.S. in virtue of his lifelong devotion to a pursuit which has beautified rural England beyond any other country, then I have no hesitation in saying that he would, even as a simple country squire, have deserved it. When he inherited the noble domain of Tortworth, 68 years ago, he found nothing more to induce him to become a leader in Arboriculture than many others have found; for his father, though an eminent agriculturist, had done little or nothing to set him an example. Loudon had laid a good foundation for more exact knowledge than our ancestors possessed of the great number of exotic trees which will thrive in this country, and the introduction by Douglas and others of numerous North American conifers, had attracted many and created a fashion for planting a "Pinetum" in many parts of England. Some of the most famous of these Pineta were made on soils or in climates which later experience has proved to be unsuitable, and in consequence when the generation which had planted them died out, they sometimes became neglected and many of the species died. But the varied soils and situations at Tortworth, coupled with the favourable climate of the vale of Gloucester, favoured Lord Ducie's early experiments so well, that he never rested in his labours till he was past ninety, when his bodily and mental powers began to fail. But his pleasure and interest in watching the growth of his trees never diminished, and he set an example to all planters by the care which he gave to his trees for many years; with the result that at Kew alone can a collection be found, so well grown, well pruned, and generally well cared for as at Tortworth.

When I first began to collect material for a more up-to-date work on the trees of Great Britain, he encouraged and assisted me to a greater extent than any other man, and was never so pleased as when he could show me in one or other remote corner of the park or plantations, some rare American oak, hickory, or other hard-wood which he had planted 40 or 50 years before. Visitors were numerous at Tortworth, and though he loved to show them round himself, he was such a conscientious man in the performance of the numerous public duties which he undertook, that he always seemed to be in a hurry to get on the next tree or the next duty, so that one had to repeat one's visits frequently in order to take in the knowledge he possessed. I well remember telling him of a tree in Lord Bathurst's park which I could not identify with certainty. He said "What is the use of your knowledge if you cannot name a tree?" and wrote to Sir J. D. Hooker to send down the late Mr. Nicholson to name it; who, suspecting, as I did, that it was of hybrid origin, identified it with *Pyrus intermedia.* But it was only after my personal visit to Fontainebleau, and a week's work by Dr. Henry in the Kew Herbarium that we came to the conclusion that it must be the same as what Gay and other French botanists, many years before, had called the Service Tree of Fontainebleau, *Pyrus latifolia.*

When Prof. C. S. Sargent of Boston and the late Dr. Asa Gray visited Tortworth about 1880 they were shown three trees natives of California, which neither of them had seen alive in their own country and which will not exist in the climate of New England. *Castanea chrysophylla,* the Golden-leaved Chestnut, was one of these, and though the Tortworth specimen is rather a great bush than a tree, it has supplied seeds for years to all who asked for them worthily; for Lord Ducie was most liberal in distributing young trees from his well-managed nursery.

Though Lord Ducie was for many years a Vice-President of the Royal Horticultural Society, and was generally interested in local geology and botany, he took no particular interest in other branches of horticulture, though Tortworth is celebrated for its fruit. He was an active Volunteer from the commencement of the movement, a distinguished marksman with the match-rifle, a yachtsman who visited Norway on many occasions, until he lost his steam yacht in a fjord there. He was for some years President of the National Rifle Association, and a most indefatigable worker in all county business. Though Lord Ducie had resisted the request of numerous friends to compile or allow to be published a catalogue of his unique collection of living trees, it is much to be hoped that such a fitting memorial of his life's work may now be attempted.

H. J. E.

ADRIAN BROWN, 1852—1919.

Adrian Brown was the junior member of the very remarkable amateur scientific quartette, Peter Griess, Cornelius O'Sullivan and the brothers Brown—Horace and Adrian, once active in the scientific service of brewing at Burton-on-Trent.

The amateur scientific worker is a peculiarly British product—he hates drill and grows through force of example, not of precept. He has not matured in countries where drill has been in the ascendant. Griess was an outstanding example. He spent six or seven years at the University—doing nothing as a formal student; the saying goes, that he wasted his time. Far from this—whilst he took his fill of student life, what to-day would be called his subconscious mind was clearly at work and he suddenly displayed extraordinary activity in the laboratory. His great ability was appreciated by Kolbe, his teacher, himself a man of the highest intelligence, to some extent trained here, under the late Lord Playfair, as fellow worker with the late Sir Edward Frankland, the ablest chemist of his time in the laboratory and the author of the theory of valency upon which our entire system of structural formulæ is based. Kolbe recommended Griess to Hofmann, then Professor at the Royal College of Chemistry, in Oxford Street, London—whence arose the dyestuff industry as the outward and visible sign of the great leader's activity and example as an original worker. Griess brought with him from Germany his discovery of the Diazo-compounds, one of the most remarkable in the history of chemistry, as it involved recognition of the fact, that nitrogen, up to that time regarded as an inert element, could form compounds of unusual chemical activity and extreme instability. He developed his discovery in London, until in 1862 he become assistant in Allsopp's Brewery in Burton-on-Trent. Here, until his death in 1888, he occupied an anomalous position, living a life all but apart from the brewery, an indefatigable worker, high up in an empyrean of constructive organic chemistry. Apparently, Griess did nothing in particular for brewing, beyond criticising its products; but he laid the foundation of a branch of the dyestuff industry which has since been the most remunerative of its many activities. His services were once sought by an English dyestuff firm, but the beggarly terms offered him were naturally declined and we lost an irrecoverable opportunity.

In the past scientific workers had their individual patrons who supported their inquiries; but the Allsopp firm behaved to their chemist in a way which is without parallel in the history of industrial enterprise; they seem to have gloried in having so distinguished a man on their staff, without considering the direct value of his services. His presence was testimony to their breadth of view, as well as to their liberality; they undoubtedly gained in repute from their action.

Horace Brown entered on his technical career, in 1866, at the time when Griess took up the position of chief chemist, at Allsopp's, vacated by Dr. Böttinger, father of the Dr. H. von Böttinger, recently deceased, who is noted for the part he played in the development of the German Dyestuff Industry. He had been influenced, as a lad, both by Böttinger and by Griess but his only didactic training in chemistry was a year spent at the Royal College of Chemistry, partly under Hofmann and partly under Hofmann's successor, Frankland.

Cornelius O'Sullivan went to Burton in 1867. He too had been a pupil of Hofmann, at the Royal College of Chemistry; he was one of the assistants in the laboratory at the time when Horace Brown and the writer entered as students. He accompanied Hofmann to Berlin but, after a few months, on his recommendation, returned to England to enter the service of Messrs. Bass and Co. An accomplished worker, he began the study of the mash-tun by investigating the action of the enzymes of malt (diastase) on starch; he may be said to have rediscovered maltose in the course of this work and to have established its significance as a fundamental unit in the complex starch molecule. Although others have followed in his footsteps, to the present day we remain ignorant as to the precise nature of the successive changes which the starch molecule undergoes on hydrolysis and of the number of enzymes concerned in the process. O'Sullivan was also the first to study, in detail, the rate at which cane-sugar was hydrolysed by yeast invertase. Finally, he undertook an inquiry into the products of the hydrolysis of gum-arabic and laid solid foundations which no one yet has built upon.

Adrian Brown did not enter the scientific service at Burton until 1873, when its foundations had been deeply laid: he then spent several years studying for the distinguished part he was to take in the quartette.

He was born at Burton on April 27, 1852. He came of a practical and nature-loving stock. His father, Edwin Brown, the son of a small builder, left school at an early age, to become clerk at a private bank in Burton, ultimately the Burton, Uttoxeter and Ashbourne Union Bank, of which he was manager during the last twenty-five years of his life. He died suddenly, in 1876, at the age of fifty-seven. He was an ardent naturalist, specially known as a coleopterist, with a strong scientific bent and leanings to all the sciences, particularly geology.

He is referred to in the 'Life and Letters of Charles Darwin' in a letter from Henry Walter Bates, the celebrated Amazonian traveller, to Darwin, dated October 17, 1862:—

> "Mr. Edwin Brown is manager in a large Bank at Burton. I have known him twenty-one years; he was my earliest naturalist friend. I have always looked on him as a man of extraordinary intellectual ability. I have given him my notices on Carabi. He is amassing material

> (specimens) at very great expense. He has never travelled; this is a great deficiency, for the relation of species to closely allied species and varieties cannot, I think, be thoroughly understood without personal observation in different countries."

In the memoir, by Mr. Edward Clodd, prefixed to the reprint of the unabridged edition of 'The Naturalist on the River Amazon,' published by Mr. Murray, in 1892, it is stated that:—

> "Bates was born at Leicester in 1825 and spent his youth in the district. Apprenticed to a hosiery business, he left it soon after his master died and eventually entered Allsopps' Brewery as a clerk."

Mr. Clodd adds:—

> "As often as he could he escaped from the desk to the open air, and some results of his entomologising are found in a paper on 'Coleoptera in the neighbourhood of Burton-on-Trent,' published in the 'Zoologist (VI, 1848, 1997). Mr. Edwin Brown, who obtained him the situation at Allsopps', is referred to as the captor of several species scheduled in the paper."

Edwin Brown appears to have exercised considerable influence upon the fortunes of both Bates and A. R. Wallace. Bates became acquainted with Wallace at Leicester, where the latter was English master in the Collegiate School. Mr. Clodd tells us that:—

> "The two friends often discussed schemes for going abroad to explore some unharvested region and at last these took definite shape, mainly through the interest excited by a little book, published by John Murray in 1847, entitled 'A Voyage up the River Amazon, including a Residence at Para,' by Mr. W. H. Edwards, an American tourist."

The writer learns from Dr. Horace Brown that this book had greatly interested his stepfather, Edwin Brown, who lent it to Bates to read. The recovery of such a fragment of history will not be without interest, as giving a clue to the mental process whereby the two travellers were eventually led to the study of problems of world-wide significance.

Adrian Brown was therefore nurtured in a scientific atmosphere. He attended the local grammar school, but his effective training was at the hands of his father and, in chemistry particularly, of his elder brother, Horace. He received his special technical training mainly at the Royal College of Science, the combination of the Royal College of Chemistry, Oxford Street, with the Royal School of Mines, Jermyn Street, then just effected at South Kensington. On leaving, he became private assistant to Dr. Russell, Lecturer on Chemistry in St. Bartholomew's Hospital Medical School.

In 1873 he quitted London for Burton, to act as chemist to Messrs. Salt and Co., Brewers.

In referring to the Burtonian quartette, which Adrian Brown was the last to join, as amateur workers, the writer is not unmindful of the fact that all were brewer's chemists and therefore professionally engaged, excepting, perhaps, Griess—and it has always been thought that he has not had sufficient credit for the work he did in the brewery. None the less, the spirit in which they worked was that of the amateur of the past: they sought neither gain nor applause: love of their art was their guiding light; they were led solely by desire to explore its fields, to grasp its value, to display its beauties.

Adrian Brown remained twenty-five years in the brewery, leaving in 1899 to take charge of the newly founded Chair of Brewing and Malting at the Mason College, Birmingham. When the University of Birmingham was established, he became Professor of the Biology and Chemistry of Fermentation and Director of the School of Brewing. He died suddenly on July 2, 1919, three days after his wife.

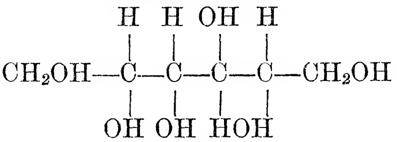
A naturalist from his birth upwards, a man of unobtrusive manner but great personal charm, he gained the esteem of all whom he met officially and the affection of his many friends. Not only was his standard of endeavour ever the highest but all he did was characterised by originality, great independence of judgment and a consistent logic.

He was not elected into the Society until 1911. His first work was in advance of the time and did not receive the attention it deserved, although the subject, the action of oxidising organisms, was one of great interest, oxidation playing so determining a part in vital activity. He began by studying the action of the well-known *Bacterium aceti*, used in producing vinegar from alcohol; then that of another organism, *Bacterium xylinum*, which he was the first to isolate from "Mother of Vinegar."

The point brought out in the earlier inquiry was the inability of *B. aceti* to condition the oxidation of methylic alcohol, although it grew in presence of this compound: then, that it was able to determine the conversion, not only of ethylic alcohol but also of propylic, to the corresponding acid; yet was without action on isopropylic and isobutylic alcohols; still, it grew in the presence of these compounds but was killed by fusel oil and amylic alcohol. These remarkable differences in behaviour of compounds so closely related remain unexplained to the present day. Assuming that oxidation be determined by a catalyst, *i.e.*, at a solid surface, it is most probable that the surface is differently affected by the different alcohols: but on any hypothesis the fact that methylic and isopropylic alcohols are unattacked, whilst compounds so close to them in all chemical properties are oxidised, is very striking; no other such marked instance of bacterial epicurism is known.

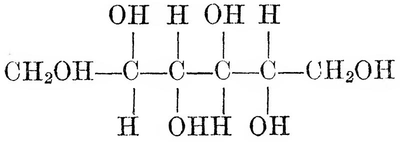
The results of his work on *B. xylinum* were of less direct significance, as his attention was mainly directed to the membrane which this organism produces in sugar solutions; he thought it was a variety of cellulose, but from later work, by Emmerling, it is probable that the product is of a chitinous character. Here again, however, a field is opened up for further inquiry—if action take place within the cell, how comes it that such a product is secreted without the organism if this be not destroyed in the process?

The activities of *B. xylinum* were studied, a few years later, by the French chemist, Bertrand, who established the fact that it has an entirely remarkable discriminative power, as in compounds sensitive to its oxidising influence two H.C.OH groups are present, not only in conjunction but so placed that the two OH groups in these are on the same side of the plane in the formula; thus when the two isomerides formed by reducing sorboses are submitted to the action of the organism



$$CH_2OH-\underset{OH}{\overset{H}{C}}-\underset{OH}{\overset{H}{C}}-\underset{H}{\overset{OH}{C}}-\underset{OH}{\overset{H}{C}}-CH_2OH$$

Sorbitol.



$$CH_2OH-\underset{H}{\overset{OH}{C}}-\underset{OH}{\overset{H}{C}}-\underset{H}{\overset{OH}{C}}-\underset{OH}{\overset{H}{C}}-CH_2OH$$

Iditol.

sorbitol alone is oxidised and reconverted into ketose (sorbose). It is in no way clear, at present, whether the selective activity displayed by the organism be that of an enzyme or traceable merely to a peculiarity in the oxidative process.

The root ideas underlying our present conception of the nature of enzymic hydrolysis are largely traceable to Adrian Brown's iconoclastic work. Beginning with observations on the rate of reproduction of yeast cells, he noticed that a constant amount of yeast fermented an approximately *constant weight* of sugar, in unit time, *in solutions of varying concentration;* the graph of his experiments was a straight line, not a logarithmic curve—indicating the change of regularly diminishing amounts in successive unit periods—such as was held to be expressive of the simple enzymic change conditioned by invertase, on the basis of the experiments made by Cornelius O'Sullivan and Tompson, published in 1890. Hence he was led to re-examine the evidence adduced by these chemists, in support of their view, that the enzymic change was a mass-action effect, strictly comparable with the changes taking place in solutions of crystalloids—in other words, that enzymic change took place in solution.

He dealt with this subject in an exhaustive manner. The conclusion arrived at was, that during the earlier period of change, as in fermentation, the sugar is hydrolysed at a linear rate, the amount converted being practically independent of the concentration of the solution, in no way proportional to it. The rate of hydrolysis is much reduced by the addition of invert sugar, that is to say, of the products of change; lactose, except in very large proportion, however, has little effect.

These conclusions have been fully confirmed by later inquiries. It may now be taken as established, that enzymic action is effected at solid surfaces. Complete confirmation of this explanation has been given by recent observations on the action of a catalyst such as finely-divided metallic nickel in determining the hydrogenation of the fatty oils.

Much of Adrian Brown's work was in criticism of Pasteur's findings, especially the great Frenchman's conclusion that fermentation was life without air; he thought that he had proved the contrary. He studied the effect of alcohol and found that it greatly retarded the reproductive growth of yeast; also the effect of carbon dioxide but came to the conclusion that, as it had no greater influence than hydrogen and as there was a much larger increase in presence of air, that the repression of growth was due to exclusion of oxygen. He was, therefore, led to favour the conclusion that reproductive growth of the yeast cell, under ordinary anaërobic conditions, is determined by the amount of oxygen at the disposal of the organism prior to the commencement of reproduction.

Recently, however, Slator, working in the laboratory of Messrs. Bass and Co., has adduced proof that not only has carbon dioxide a greater influence than has been supposed on the activity of the yeast organism but also that oxygen is not required for reproductive growth of the cell—thereby upholding both a common opinion of carbon dioxide and Pasteur's view as to oxygen being unnecessary.

It remains to consider what is undoubtedly his most remarkable work—that on diffusion into the barley corn, noteworthy both on account of the beauty and delicacy of the method he developed and the significance of the results. Having eyes to see as well as an inquiring mind, he was led to take special notice of the blue layer just below the skin in certain varieties of barley. Desirous of finding out what happened, in the malting process, when barley was steeped in water, as it is during the preparation of malt, also what would be the influence of impurities in the water, he first studied the behaviour of dry barley-corns in water and then in various solutions. He saw that in blue barley he had a perfect mechanism for the quantitative study of diffusion phenomena. The blue layer furnished the discriminating membrane; the finely granular mass of starch within the corn served to attract water into the grain. By placing a set of weighed corns in water and at intervals removing them and determining the increase in weight, at various temperatures too, the rate at which water entered was easily ascertained. The variation in the rate at which it accumulates in the grain, as the temperature is raised, was in agreement with that at which the vapour pressure of water rises when this is heated.

A similar tale is told by solutions of most salts and of substances such as the sugars—these all have vapour pressures lower than that of water and water accumulates less rapidly in barley corns placed in these solutions than if they were in water, the rate depending on the concentration.

Solutions of the ordinary strong acids and alkalis also give up water to dry barley corns and become concentrated but no acid passes across the discriminating membrane; the blue colour remains unchanged in all sound corns.

But weak acids, also weak alkalis, such as ammonia, readily pass through; moreover, the membrane is penetrable by all chemically neutral substances at all soluble in water—such as acetic acid and its homologues, chloroform, even hydrocarbons such as benzene. These all pass into the corn together with water and actually accelerate the passage of water into the grain. It is no question of molecular size: such molecules do not penetrate the membrane because of their smaller size; on the contrary, butyric acid enters more rapidly than acetic and the alcohols of the ethylic series pass through the more rapidly the greater their molecular weight, so long as they are reasonably soluble in water.

Eventually an equilibrium is reached within the corn and the concentration of the solution may become higher than in the liquid outside; it has even been observed, in the case of phenol and aniline, that the internal solution is "supersaturated." To take an example, when the corns are saturated in a solution containing 50 per cent. of acetic acid, the solution within contains 80 per cent. of the acid—but this is the limit, no more passing in from stronger solutions.

Previous observers on the passage of such substances through living tissues have correlated their relative activity and their lethal power with the solubility in fats, and have postulated the existence of a lipoid layer at the tissue surfaces. Adrian Brown's observations justify us in putting aside all such fancy explanations—the correlation is of consequence only in so far as the solubility referred to of substances in oils and fats is usually the converse of their solubility in water.

A full discussion of the work Adrian Brown accomplished and its bearing on contemporary inquiries, by the writer, is published in the 'Journal of the Institute of Brewing,' 1921, vol. 27, pp. 197–260. From the point of view advocated in the present notice, his exemplary career and achievements merit most careful attention. His genius lay not on the surface but was manifest in a continuity of effort which, in sum, was remarkably effective. His work was an expression of himself: it came from within; but that he was induced, if not forced, to display his genius owing to the influence of the conducive environment in which he was placed is probably a not unwarrantable conclusion. Chamber music such as the Burtonians have discoursed so successfully might well and should be more cultivated, not only in industry but in the new Universities, even at Oxford.

H. E. A.

LOUIS COMPTON MIALL, 1842—1921.

Louis Compton Miall was born at Bradford in the year 1842, and was the fifth living son of a Congregational Minister, the Rev. James Goodeve Miall. His mother was Elizabeth Symonds Mackenzie. The teaching element was strong on both sides of his family. The Mialls had been schoolmasters and preachers for generations. One of them, Moses Miall, had published a book of Practical Remarks on Education. The Mackenzies were also much given to schoolmastering, and had come strongly under the influence of the Edgeworths, whose educational methods were firmly established in the family tradition. Sir Morell Mackenzie and Edward Compton, the actor, were first cousins of L. C. Miall on the Mackenzie side, and Edward Miall, M.P. for Bradford and Editor of the 'Non-Conformist,' was his father's half-brother.

The Rev. J. G. Miall was a man of varied attainments, and had a distinct gift for teaching. He bestowed much pains on the training of his children, for he knew that they would have to fight their way in the world on their own resources. He was very particular to train them in self-reliance, to give them studious tastes, and the power of expressing themselves well. He had himself a beautiful speaking voice, which the children all inherited in varying degree, and he taught them to make the best use of it.

L. C. Miall owed much also to his mother. She, like her husband, had a pleasant voice and manner and much charm of personality, and she had a power of holding her children's love and admiration which far exceeded his. She was, above all things, deeply religious, but had so courteous and sunny a disposition that religion, even the terrible early-Victorian religion, could not make her gloomy.

Louis seems to have been an enterprising and high-spirited child, keen about games and mischief, and inclined to wander away from home on solitary expeditions. He was sent first to a little school near his home, and, later, when he was 9 years old, to Silcoates School, near Wakefield, then, as now, a boarding school for the sons of Non-Conformist Ministers.

At the time that he left school, L. C. Miall's interests were all classical and literary. He had learned little mathematics and no science, but had shown himself good at essay writing, and had stored his mind with fine passages from Shakespeare and the Latin poets. He said in after life that he knew nothing of Natural History as a schoolboy, though he tried to make friends with a half-witted boy who could show him, as if by magic, all sorts of strange nests and creatures in places where no one else would see anything. But even in those days he must have been unusually observant, for he tells in the "Natural History of Aquatic Insects" how he and his companions watched the dragon-fly escape from its pupa-case, and how they saw the larva, " with its dingy colours, its forbidding shape, and its predatory habits . . . stretch out its great paw and secure an unsuspecting victim."

In 1857 Louis Miall left school, a boy of fifteen, but looking older, and already grave and dignified. He had probably learnt all that Silcoates had to teach him, and his father could afford to spend no more upon his education, but recognised the lad's ability, and, being anxious to give him further opportunities to study, hit upon a scheme that seemed promising from many points of view. This was that Louis should keep a little day-school, with his father's help and direction, prospectuses for which were accordingly issued in Louis's name. A member of the congregation, who much admired the minister and knew something of his teaching capacity, had already entrusted him with her son's education, and other pupils were soon found to make the nucleus of a small school. The time-table was specially arranged so that Louis should have leisure for private study; his father apparently took a good deal of the teaching into his own hands, and his mother helped with the French, and, altogether, the plan seemed to work out very well. It had its drawbacks, however, the chief of which was that Louis had to study by himself, for, though his father could help him with Latin and Greek, the boy had then no great inclination to continue his classical reading, and was more interested in the new scientific subjects that were attracting the attention of the younger generation.

His eldest brother was a medical student at Edinburgh and Louis often envied his opportunities. Probably it was his example that induced Louis later on to take a course of anatomy at the Leeds School of Medicine. It meant early rising every day to journey from Bradford to Leeds, but the teaching was good and constituted the only training in science that he could obtain.

Meanwhile he was working hard at zoology and geology, and joined a Botanical Society at Todmorden, making many friends who were interested in Natural History and publishing papers in various periodicals. One of these brought him the following letter from Charles Darwin:—

Down, Bromley, Kent.

DEAR SIR, January 23, 1860.

I hope that you will excuse the liberty I take in writing to you and requesting a favour. In the 'Annals of Nat. Hist.,' vol. 15, p. 39, you remark "The variations of form in the maxillæ are of no value among the Phalangida in affording generic or specific characters as with the true spiders." Am I to understand from the latter part of sentence that with the individuals of the same undoubted species the maxillæ vary in form? Is not this a very surprising fact? Would you have the great kindness, if the fact be so, to give me some details on the amount and kind of variations and in what species. And further would you permit me to quote any such facts on your authority?

With many apologies for troubling you, I beg to remain, Dear Sir,

Yours very faithfully,
CHARLES DARWIN.

One wonders what answer was sent, and whether Darwin was aware that his correspondent was a boy of eighteen.

A couple of years later appeared the "Flora of the West Riding" by Miall and Carrington, with an introduction by Louis Miall, which he repented in later years; for, though it has merits, it is written in a rather high-flown style, and to publish a list of plants and their localities was quite contrary to his maturer teaching.

Besides the difficulty of studying without teachers, there was another drawback to the life that he was leading at this time. His father was strong-willed and autocratic, and Louis' own strong will was frequently at variance with his in the management of the little school. The young man's scientific studies, and the spirit of the age when Darwin and Huxley were fighting for freedom of belief, soon brought religious disagreement into the family circle and Louis' change of faith was a great grief to his parents. It hit his father on all sides, as parent, schoolmaster and minister, and he felt it very bitterly. Altogether the life was neither happy nor hopeful, and the young man decided that it could not continue. He would find work elsewhere, and eventually he took a post as assistant-master in a school kept by Mr. George Todd at Stamford Hill, near London.

Towards the end of the second year there the situation was changed by a letter from his brother Philip, telling him that a Philosophical Society was being started in Bradford, and that Philip was commissioned to write and offer him the post of Secretary to the Society with a salary of £100 a year. This was just what he wanted. He wrote an immediate acceptance and gave notice to leave the school at the earliest moment possible.

This was the turning point in Louis Miall's career. After six or seven years of gradually increasing darkness and discouragement, the horizon cleared, and henceforth he advanced without faltering. When he returned to Bradford he was very raw and inexperienced and had little idea what to make of his new task. The first thing he had to do was to arrange a course of lectures, under the guidance of the Committee, who soon left all the correspondence in his hands. An interesting course of lectures was given between 1865 and 1871, among others by Owen, Huxley and Rolleston, who thus came into personal contact with the Secretary of the Bradford Philosophical Society.

Another thing to which the Secretary had to turn his attention was the making of a museum from a collection of objects mostly given by people who wanted to get rid of them. He finally decided that the only thing he could do was to make a collection of geological specimens for which the neighbourhood offered unusual facilities. He prepared a report to the Committee, in which he offered to collect what he could from the coalfields and limestone districts within reach. For some years it was his delightful hobby to explore the district of Craven, to study its geology and to collect its fossils. A frequent companion of his on these rambles was John Brigg, afterwards Sir John Brigg, M.P. for Keighley, a member of his

Committee, who took a great interest in the young Secretary and influenced him in many ways.

In the course of these excursions quite a respectable collection of fossils and geological specimens was made for the Bradford Museum. Then a great piece of luck befel the Curator. One day there came into his office a coal miner bringing some curious bones that he had found in the Low Moor coal mine. Miall went to see them himself next day, going down a coal mine for the first time in his life. He was shown the bones on the roof of a passage in the works, and realised that they would require very careful treatment if they were to be removed without injury. So it was decided to apply a layer of plaster of Paris to protect the bones and then to have the coal carefully worked away, a prop being placed to support the fragments covered with plaster. The bones were removed in perfect condition except for those that had already been broken off. The block removed was 11 feet long and a couple of feet wide. Investigations proved that the bones belonged to a Labyrinthodont of a species that was hitherto unknown. On the suggestion of the Committee, Miall wrote to Prof. Huxley and offered to take the fossil to London and show it to him. Huxley sent an encouraging reply, the fossil was carefully packed in a wooden case and taken to London, where it was examined with much interest by Prof. Huxley and Prof. Flower. Huxley undertook to write a description of it for the Geological Society and asked Miall to prepare a short account of its discovery and removal from the coal mine. At the next meeting of the Geological Society, Miall read his paper and Huxley gave a simple and interesting account of the new Labyrinthodont, without notes, explaining it from the specimen as he went along. Sir Charles Lyell was present and seemed to be much interested.

When Miall returned to Bradford and gave the Committee of the Philosophical Society a vivid account of what had passed, they asked him to repeat the story in the form of a lecture to the Society. It was his first public lecture. After spending a good deal of time trying to write it out, he resolved to follow Huxley's example and speak without notes, explaining the actual specimen before the audience. There was a good attendance, for the matter had aroused interest in Bradford, and the lecture went off very well. That was the beginning of Miall's career as a public lecturer. After that we find him giving courses of Lectures in Bradford and Leeds mostly on Geology, but also on Botany and the "Early History of Domestic Animals."

Though very shy and studious, Miall seems to have entered somewhat into the social life of Bradford, which happened to be unusually interesting at that time. He was fond of music, and indeed had studied it in his usual way by sheer force of will and without a teacher, so that he had written songs for his sister and could play to some extent on two or three instruments. He also had a good deal of talent for painting. He brought back from a cruise in the Hebrides in 1868 sketches from which he made some clever little water-colour pictures, that still hang beside one or two of his father's in homes of a younger generation.

At Bradford he met his future wife, Emily Pearce, to whom he was married in 1870. Though not scientific, her intellectual and social gifts were, in some directions at least, equal to his own.

In 1871 L. C. Miall was appointed Curator to the Leeds Philosophical and Literary Society. He had already delivered a course of lectures on geology to the Society and was known to several influential people in Leeds. He must have had Huxley's support, too, in his application, for among his letters of congratulation on obtaining the post was one from Huxley, in which he characteristically remarks that it would be a matter of great satisfaction to him to think that he had in any way contributed "to the putting of an indubitably square man into the square hole at Leeds."

His interests at this time were mainly geological, and he devoted himself to the collection of fossils in the Leeds Museum with the same enthusiasm that he had given to the geological collection at Bradford. He was helped in its re-arrangement by Pengelly, Boyd Dawkins, and others. Later, much help and many specimens were given by A. H. Green. When it was re-arranged, he wrote a guide to the collection; in the same way he re-arranged the different collections of birds, insects, antiquities, and so forth, and wrote a guide to each, in which he set forth clearly the general principles of the various subjects.

Since 1869 Miall had been busy with the investigation of the new Labyrinthodont that had been found in the Low Moor coal mine. The task proved more difficult than he had expected. He was Secretary of the Geological Section of the British Association at Edinburgh in 1871, and a Committee was then formed, consisting of Phillips, Woodward, John Brigg, and three others, with Miall as Secretary, to investigate and compare all the known species of Labyrinthodont. It happened that the following summer John Brigg and his friend, Swire Smith (Sir Swire Smith, whose life has been written under the title of 'The Master Spinner'), decided to go to Germany to look into the German system of education and see for themselves how far such a system would be possible in industrial England. They invited Miall to join them, so that he and John Brigg could combine the investigation of Labyrinthodonts with the educational work, all three being in fact interested in both subjects.

They had an instructive tour, and the following year (1873), when the British Association met at Bradford, Miall read the report of the Committee on Labyrinthodonta. The work had been very thorough: "Some of the members have personally examined all the more important Labyrinthodonta in European collections, including at least one example of every species recorded from the British Isles." The report created much interest and brought Miall into general notice for the first time.

Miall was now beginning to concentrate his attention on Biology. He declined the Professorship of Geology at the newly opened Yorkshire College in favour of A. H. Green, a much stronger geologist than he felt himself to be, and henceforth his interest in geology began to wane. He never cared greatly for mere collection and the minute characteristics of the shells in which animals had lived. He collaborated with A. H. Green, Thorpe, Rücker, and Marshall in a work on 'Coal, its History and Uses,' published in 1878, but his serious interest in geology and palæontology ended about the year 1880. He never studied petrology, without which much of the recent work cannot be appreciated.

When Miall refused the Professorship of Geology, the Council of the Yorkshire College still wished to secure him upon its staff, and appointed him the following year (1875) lecturer in Biology, a post which he held concurrently with his curatorship of the Museum. In 1876 he was made Professor of Biology. Many of his lectures were given in the library of the Philosophical Society, for the Yorkshire College had little accommodation, while there was room and a store of material at the Museum. The professors of the Yorkshire College frequently gave lectures to the Philosophical Society and sat on its Council. Both institutious worked in conjunction with the Leeds School of Medicine, which required courses of Botany and Zoology for its students.

It was in the yard of the Medical School that Miall dissected the Indian elephant which chance gave into his hands. A shed was built over the animal, and there he worked through the cold winter of 1874–5, helped by F. Greenwood, Curator of the Medical School. The memoir on the "Anatomy of the Indian Elephant" appeared in 1879, and was the second of a series of studies in comparative anatomy. The first of the series was the "Skull of the Crocodile," which appeared in 1878, and the third was the "Structure and Life-History of the Cockroach" (1886). There the series ended abruptly, for though a short account of Megalichthys, a ganoid fish of the Coal Measures, was published in 1885, the fourth book of the series, which was to have dealt with that topic, was never written. The author had given so much time to the Cockroach, and had become so deeply interested in it, that all other research had to give way to the structure and life-histories of insects, which occupied him as long as he had vigour and eyesight for the work.

The book on the Cockroach, published in conjunction with Alfred Denny, was by far the most important piece of work that Miall had done so far. It represented several years of study, begun in the Museum of the Philosophical Society, and carried on at the Yorkshire College and at his own home. It has since been recognised as marking an epoch in the study of insects in this country. In reading up the subject as a preliminary to further research, he had become acquainted with the work of the old naturalists, Malpighi, Swammerdam, Lyonnet and Straus-Durcheim. He found them so fascinating that the first chapter in the "Cockroach" is devoted to them, and the whole book is an exposition of their teaching—a very lucid account of insect structure and development. Its value was immediately recognised by Prof. Huxley who congratulated Miall on the book.

The "Cockroach" appeared in 1886. In 1887 we find its author already occupied with another insect, Chironomus, the Harlequin Fly. This was chosen because of its abundance nearly all through the year, its transparency (in contrast to the Cockroach), and the ease with which it can be reared. Besides which, he says, Chironomus, in its various stages, has a very special biological interest. His attention was concentrated upon it for several years. The " Structure and Life-History of the Harlequin Fly," by Miall and A. R. Hammond, did not appear till 1900, though most of the work was done by 1892.

Soon after he began work on Chironomus, Miall visited Leyden to consult some books there. Every letter of this period has some reference to Chironomus, and we even find him "reading Dutch for the sake of Chironomus"; but, nevertheless, he found time to write on educational topics in the 'Journal of Education' and to devise "Object Lessons from Nature," which appeared in book form in 1891.

Nature-study had not at that time become a universal subject of school teaching, but object lessons were given habitually by many teachers. The "Object Lessons from Nature" were intended to emphasise the value of natural history in furnishing object lessons for children. In 1878, a course of nature object lessons to children had been given at the Museum of the Philosophical Society, under his direction, so that the idea was not a new one to him.

A natural development of this was the Saturday morning class for teachers which was so valuable a feature of the Biological Department for many years. The school-masters and mistresses came at first with the idea of getting up a few object lessons for their schools, but eventually many of them came year after year from love of the work, and were the most enthusiastic students that attended the Department. It was a considerable tax on the energy of the staff, and Miall was fortunate in having the hearty co-operation of all concerned. A further extension of this work with teachers took the form of three summer courses in nature study, given in 1901 and the two following years, at Berwick, Rothbury, and Hexham. Here, again, he had the help of his staff, and all looked back with pleasure on the experience.

The investigation of Chironomus led to that of aquatic insects in general, and, in 1891, Miall gave one of the public lectures to the British Association at Cardiff on " Some Difficulties in the Life of Aquatic Insects," treating specially their means of overcoming the surface tension of water. He also read a paper on floating leaves in connection with the same difficulty. A piece of work on Transformation of Insects, which appeared in " Nature " in 1895, was also a product of the Chironomus investigation, and that year, five years before the book on the Harlequin Fly was ready, Miall completed the "Natural History of Aquatic Insects," a semi-popular book on the subjects that he was studying. As in the " Cockroach," he draws attention to the work of " certain old zoologists—Swammerdam, Réaumur, Lyonnet, and De Geer—who are at present unjustly neglected." "Some passages in this book," he says, "if taken alone and read hastily, may appear to disparage systematic zoology. This is far from my intention. No one can study the great naturalists of the seventeenth and eighteenth centuries without feeling how seriously their work is impaired by the defective systems of the time. It is not systematic, but aimless work that I deprecate—work that springs from no real curiosity about nature and attempts to answer no scientific questions." The book was illustrated by A. R. Hammond, who collaborated with Miall in the production of the "Harlequin Fly," and made most of the beautiful illustrations for that work also.

In 1892, Miall's many preoccupations obliged him to give up the Curatorship of the Philosophical Society, though he still continued to serve on its council. About this time he left Leeds and went with his wife to live at Ilkley, as their children were all scattered for the moment. He subsequently took a house at Ben Rhydding, where he wrote "Round the Year," a series of nature studies, in some respects the most memorable book that has appeared from his pen. He was by this time 54, and henceforward undertook no new work that involved much close microscopic investigation, such as he had given to the Cockroach and the Harlequin Fly, but devoted himself rather to general topics of natural history and to educational work. "Round the Year" may almost be regarded as a piece of literature; it has been compared with Gilbert White's Letters and was written in the same spirit, not as work, but as a pleasant relaxation in the twilight of a busy day. It led to the study of Gilbert White, and to the preparation of a new edition of the Natural History of Selborne in conjunction with Dr. W. Warde Fowler. It was followed, in 1904, by another book of the same kind, "House, Garden, and Field," which has not quite the freshness of "Round the Year," and was meant partly to satisfy the teachers who were clamouring for more object lessons. The author thought it would be better if they made their own lessons, and that nature study could not be taught effectively by those who lacked time or inclination to do so, but he was quite willing to suggest topics for those who cared to develop them.

In 1897 appeared "Thirty Years of Teaching," which embodies his experience in various kinds of teaching, including the education of his own children. A good deal of it had been printed in the "Journal of Education," and was written in the train going to and from Leeds. The most important feature of the book is the method of treating University or College students which it advocates—a method not indeed new, except as applied to them.

When the British Association met in Toronto in 1896, Miall was President of Section D. His address to the section was an eloquent plea for studying *life*, the modes of growth of individuals and races, the causes of decay and extinction, and the adaptation of living organisms to their surroundings. "The animals set before the young zoologist are all dead; it is much if they are not pickled as well," he complains, and he asks why we study animals at all, giving various answers to the question, but ending "to know more of life is an aim as nearly ultimate and self-explanatory as any purpose that man can entertain." Furthermore he urges the historical method of treating various biological subjects, and shows how much keener interest can be aroused in such a topic as the Alternation of Generations by finding out step hy step how it was discovered, and sharing the discoverer's own enthusiasm, than by taking it as a mass of cut-and-dried facts.

After spending half a dozen very pleasant years at Ben Rhydding, Miall moved back to Leeds, partly for the convenience of the two sons who were then at home again, and he remained in Headingley till he gave up his Professorship in 1907. The last years in Leeds were much occupied with methods of teaching, and he now attended the new Education Section of the British Association when he happened to be present at the meetings. In 1903 he was chairman of a committee to report on the teaching of Botany.

In 1902 appeared a volume on "Injurious and Useful Insects," an excursion into economic entomology, which he felt to be an important field of investigation, needing especially complete life-histories of insects to make it valuable. No doubt the main idea was right and has since been followed up with good results, but Miall was not himself in close enough touch with agriculture to make the book altogether a success, from the economic point of view. The life-histories of insects that it contains are, however, still useful to economic entomologists.

At the inauguration of the University of Leeds in 1904, Miall was given the Honorary Degree of D.Sc., the only academic distinction that he ever attained. That year and the year following he had the honour of holding the Fullerian Professorship at the Royal Institution. At that time also he was asked to serve on the Council of the Royal Society, but unwillingly declined as he had already so much on hand.

In 1908, after his retirement to Letchworth, he was President of the Education Section at the British Association in Dublin, and that was the last meeting that he was able to attend, on account of increasing deafness. Many activities had to be given up for the same reason, but he was still able to carry on individual teaching. From his wife, who was as keen an educationist as himself, he had learnt the direct method of teaching modern languages and applied it in a way of his own to the teaching of Latin, writing out a series of oral lessons and learning, when over seventy, to speak Latin fluently with the modern pronunciation. Since his school days, he had never altogether neglected his classical studies and, though he sold most of his books when he left Leeds, he had kept such Latin and Greek authors as he happened to possess.

It might be noted here that all his life he loved books and was interested in the care and binding of them. He was for many years Hon. Librarian of the Yorkshire College. The only half-disparaging remark he was known to make about Charles Darwin referred to the ruthless way he treated books.

Writing was an occupation that he maintained to the end of his life. The first book that he wrote at Letchworth was the "History of Biology," a clear and illuminating résumé of the subject that led to the more important work on the "Early Naturalists (1530–1789)." It begins with an introductory chapter on Natural History down to the 16th century, and consists mostly of biographical sketches of the old naturalists he loved so well, but there are also digressions on "The Natural History of Other Lands and the Investigation of the Puss Moth and of the Flower." Of this book Dr. Warde Fowler remarks: "He fairly astonished me, after a visit here at Kingham, by sending me as a gift the five splendid volumes on insects of Réaumur, and later on his own book on the 'Early Naturalists,' one as great a treasure as the other, for his own beautiful English was as clear and enjoyable as Réaumur's French."

Miall's great force lay in his absolute sincerity. Though he could write well, and even brilliantly, he never wrote for effect. Everything that he published represented all the careful research and investigation that the subject demanded. His first attempts at solving a problem were usually wrong, he tells us, and in regard to one of his later books he says that every time he looked up a fact in the British Museum, he found two fresh ones that required investigation. "Fortunately," he adds, "I am not pressed for time."

"The Early Naturalists" was the last book he published. He spent some years on "A History of Garden Craft" which was ready for publication when the war broke out in 1914, but was then put aside, and after that he wrote no more books. He wrote an occasional paper, carried on a correspondence (sometimes in French) with one of his brothers, and made letter-writing rather a hobby. Gardening had long been a hobby of his and he had given a good deal of attention to the laying out of his new garden at Letchworth.

On the death of his wife in 1918, my father came back to his favourite haunts in Ben Rhydding and remained there till his last illness. He died on February 21st, 1921, at our house in Leeds. By his own wish there was no religious service at his funeral, a few words of farewell being spoken by his friend, Prof. Smithells, in the presence of a small gathering of relatives, old friends and colleagues. Nevertheless, the religious enthusiasm which inspired his early manhood had never altogether left him, his attitude to life and the unknown was always reverent, and the influence he exerted on those among whom he worked was spiritual as well as intellectual.

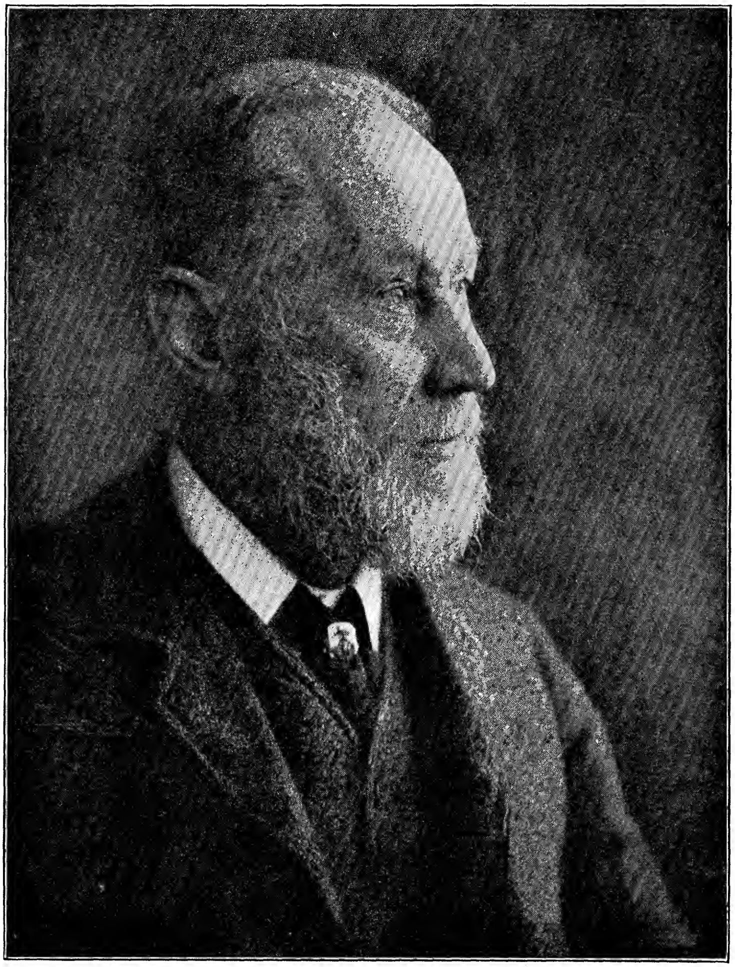
W. W.

GEORGE STEWARDSON BRADY, 1832—1921.

G. S. Brady, M.D., M.R.C.S., D.Sc., LL.D., F.R.S., C.M.Z.S., Professor of Natural History, Armstrong College, Newcastle-upon-Tyne, and Consulting Physician to the Sunderland Infirmary, was born, he told me, April 18th, 1832. Presumably also on his authority we learn that the event occurred at Gateshead, and that he was the eldest son of Henry Brady, surgeon.

As his childish education began at the Friends' School, Ackworth, it is not improbable that he owed the name Stewardson to his parents' acquaintance with the Quaker family which gave the popular portrait-painter of that name to the early part of the nineteenth century. Certainly the whole tenor of Brady's life seems to have been in tune with the principles of that peace-loving community, and even on the scientific side there are many indications that friendship was his delight. It has been already explained in 'Nature' (January 5th, 1922), among other details, that he became a member of the Tyneside Naturalists' Field Club in 1849. At that early period it is said that his interest was "with algæ and other plant groups." Much later on he referred to these studies when pointing out in correspondence (November, 1902), that the organisms which I had described as gland-cells in the amphipod genus *Urothœ,* were, in fact, "parasites, probably algæ."

With the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, of which the Tyneside Field Club was a branch, Brady had a long and distinguished connexion, both as a frequent contributor to its 'Transactions,' and twice President of the Field Club. The respect felt for him by fellow-workers in systematic zoology may be partially traced by the use of his name in classification. Thus among Copepoda Axel, Boeck names a genus *Bradya* in 1872, Thomas Scott supplies *Neobradya* in 1892, Giesbrecht *Bradypontius* in 1895, and *Bradyidius* in 1897, Vanhöffen *Bradyanus* in the same year, and G. O. Sars *Pseudobradya* in 1904. Sars had named a genus *Bradycinetus* in 1865. But this suggests a curious need for caution in that many generic names owe the commencing syllables Brady-, not to eminent zoologists, but to the Greek *βραδύ,* indicating some organic slowness, and very inappropriate to the scientific activities of George Brady and his brother Henry. For the use of the former's name in identifying species, his friend A. M. Norman led the way with the Ostracode *Cythere Bradii* in 1864. But this, for technical reasons, gave way to another species, the Marquis de Folin's *Cythere Bradii* in 1869. Norman, in 1878, named a Copepod *Cervinia Bradyi,* Sars in 1884 another of that group *Undinopsis Bradyi,* and Thomas Scott a third in 1892 as *Tetragoniceps Bradyi,* but this, later on, he found reason to place in a new genus with the long-flowing name of *Phyllopodopsyllus,* strictly meaning "a leaf-footed flea," the species being notable for "the large size and leaf-like form of the fifth pair of thoracic feet of the female." In a footnote to *Tetragoniceps Bradyi,* Dr. Thomas Scott



George S Brady

remarks, "the name is given in compliment to Prof. G. S. Brady, who instituted the genus, and to whose untiring and disinterested kindness the author of these notes owes much of his success in the study of the Entomostraca." In 1879 Dr. Norman again pays his friend the compliment of using his name for a species, this time in the eccentric group of the Sympoda, to which he adds the description of *Diastylis Bradyi.*

In the previous year the Ray Society had published the first volume of Brady's "Monograph of the free and semi-parasitic Copepoda of the British Islands." As the uninitiated may be excused for wondering why men of ability should spend a considerable part of their lives in studying creatures so insignificant in size and so generally harmless to mankind, as the Entomostraca, it may be observed that, as in old Camden's phrase, "many a little makes a mickle," and as little grains of sand may make a mountain, so the stupendous multitudes in which some of the entomostracan species occur make them indirectly yet ultimately important contributors to human food and comfort. But, apart from economic values, the true lover of nature finds in this seemingly trivial study more than one source of æsthetic fascination. In the introduction to Brady's last-mentioned work he says:—"Some of the pleasantest and most profitable hours which I have ever spent have been when, after a day's dredging, I have set out at sunset on a quiet boating excursion for the purpose of capturing such prey as could be got in the surface net. Many hours of this kind, spent in the company of my old friend Mr. David Robertson, amongst the Scilly Islands, on the Firth of Clyde, on the sheltered bays of Roundstone and Westport, or on the stormier coasts of Northumbria, will long live in my memory, not only by their results in the acquisition of valuable specimens, but as times of unalloyed delight in the contemplation of nature under a different guise from that in which we usually see her." The David Robertson to whom he here alludes, otherwise known as "the Naturalist of Cumbrae" (see his 'Life by his Friend,' 1891), began a notable career as a penniless herdboy, and ended it an Hon. LL.D. of Glasgow University.

In the bibliography to his luminous work on the Ostracoda of the Bay of Naples and the adjacent seas (1894), G. W. Müller enumerates twenty-one contributions by Brady to this branch of Carcinology, together with seven others in which his was the leading name in a collaboration. Five of these were undertaken with David Robertson, one with Norman, and one with Crosskey and Robertson together. When the first volume of the "Challenger" Reports on Zoology was published in 1880 under the editorship of Sir C. Wyville-Thomson, Brady was already a recognised authority on the Ostracoda. He was among those specially consulted as to the disposal of the vast "Challenger" material, and his was the third memoir to appear. It was illustrated by forty-four quarto plates. For the comparative fewness of new species he explains that the "work of the 'Challenger' gave us no collections whatever from between tide marks, nor from the laminarian zone, and these two zones usually swarm with microzoic life of all kinds." A later work of much importance was that which he carried out in partnership with Canon Norman on "The Marine and Freshwater Ostracoda of the North Atlantic and of North-Western Europe," the first part appearing in 1889, the second in 1896. In this he gives a signal example of his scientific ingenuity which is worthy of additional record. He points out (p. 622) that "In consequence of the small size of Ostracoda it is extremely difficulty to procure spirit-preserved specimens from the deep sea, and although the *Myodocopa*, being much larger than the *Podocopa*, would be detected by the experienced eye of a Carcinologist who had studied them, yet the Zoologists usually attached to Government Expeditions cannot be expected thus to notice them. Hence it is that in a large number of cases the only examples which have come into our hands are such as have been picked out of dried material. It struck us that, notwitstanding their dried condition, it might yet be possible by maceration to get some idea of the withered inmates of the shells. We therefore made experiments, and succeeded in restoring the animals beyond our most ardent expectations. All the portions of the animals figured [in several genera and species mentioned] have been taken from dissections of animals which have been preserved in a dried state for very many, in one case, as long as twenty-three years, and we are satified that these drawings will be found to be almost as exact, so far as they go, as those taken from spirit-preserved examples."

In 1884, when the editing of the "Challenger" Reports had passed into the vigorous hands of John Murray, the eighth volume of Zoology appeared, having as its opening treatise Brady's Report on the Copepoda illustrated by fifty-five carefully drawn plates. Though the collection thus laboriously discussed presented many points of interest, Brady was forced to admit that it was far from representative of what the ocean's resources were likely to contain, and that the last word had not been said as to methods of preserving these organisms. In his Introduction he makes some remarks which bear on a subject previously mentioned:—"The appearance of these minute creatures at the surface depends upon conditions, the nature of which we scarcely at all understand. Night, on the whole, seems to be more favourable than daytime, but even during the day they sometimes appear in numbers so vast as to colour the sea in wide bands for distances of many miles. This appearance has been noticed, perhaps, most frequently in the tropics; but even in the Arctic seas some species, especially *Calanus* (*Cetochilus*) *finmarchicus*, are at times so abundant as to constitute, it is said, a most important item in the food of the whale. So far, indeed, as number and size of individuals are concerned, it would appear that the cold water of the Arctic and Antarctic seas are even more favourable to the growth of Copepoda than the warmer seas of the Tropics."

With his frequent and arduous contributions to scientific literature Brady combined, from 1857 till about 1890, the conscientious exercise of an exacting profession, practising as a doctor in Sunderland, "and after that gave up his time to his professorship at the Armstrong College, until he resigned in 1906 and . . . . came to live in Sheffield." His professorship he had held since 1875. He married in 1859 and had one son and three daughters, losing his wife ten years and his son one year before his own death. Two of his daughters are married to members of his own profession, one to Dr. Charles Atkin of Sheffield and another to Dr. R. S. Hubbersty of Sunderland, the third remaining with her father to the close of his days. He died on Christmas evening, 1921. Till the last year of what he himself described as his long and happy life, he had never realised that he was old. Apart from science his amusements had all been of a tranquil kind—gardening, photography, and the game of bowls. A friend, who had been reading over many of his writings, tells his daughter that: "Dominating all is the intense love he had for nature, religion, and poetry." Another friend, who often walked with him, tells her of the enjoyment derived from the humour, instruction, and high tone of his conversation. A long correspondence is in harmony with these touches of character.

A letter from Sheffield, dated June, 1915, shows him at eighty-three, away from necessary books, reluctant to undertake fresh work of importance, yet unable to be disobliging. He explains that he had declined an invitation to describe the *Ostracoda* and *Copepoda* collected by the Australasian Antarctic Expedition, 1911–1914, under Sir Douglas Mawson, but that the material had nevertheless been sent him, with further pressure. Now, the Scientific Records of that Expedition show that in Series C the fifth volume contains monographs on the *Copepoda*, the *Cladocera*, and *Halocypridæ*, by G. S. Brady. A fine finish!

T. R. R. S.

FRANCIS ARTHUR BAINBRIDGE, 1874–1921.

In the death of Francis Arthur Bainbridge, at the early age of 47 years, Physiology has lost an enthusiastic and successful investigator and a teacher of ability and influence. He was elected to the Fellowship of the Royal Society in 1919, and it was but a few months later that he showed the first definite signs of the ill-health, which culminated in a brief, acute illness, and death on October 27, 1921.

Bainbridge entered the Leys School with a scholarship in 1888, and passed from there in 1893 with an entrance exhibition to Trinity College, Cambridge, of which foundation he subsequently became a major scholar. His student career was on normal lines for a man of his ability and studious habit, but, on finishing the Natural Sciences Tripos, in both parts of which he was placed in the first class, he left Cambridge for St. Bartholomew's Hospital, shaping his course with a view to the practice of medicine. After qualification, he held several minor appointments in physiology and pathology, while waiting for opportunities of advance in the career which he had then chosen; but his natural bent was already obvious, in the devotion of the time which he could spare from his official duties to research in physiology, which he carried on in the physiological laboratory at University College.

In this period he made a series of investigations into the mechanism of lymph-formation, which brought clearly into view the influence of activity in gland cells on the outpouring of lymph from the blood-vessels of the gland. These and other phenomena of lymph-formation, which some had regarded as indicating a process of active secretion by the capillary endothelium, he brought into harmony with Starling's simpler physical conception, producing ingenious experimental evidence in support of that point of view. He became active also in the new field of investigation opened up by Bayliss and Starling's discovery of Secretin, which was made at this time. Bainbridge, however, unable as yet to give to physiology an undivided allegiance, had neither the time nor the impulse to acquire that full command of specialised technique and experience needed for an essentially biochemical investigation. When eventually, in 1905, he abandoned the idea of medical practice, it was to accept the Gordon Lectureship on Pathology at Guy's. Here, with A. P. Beddard, he began a series of elegant experiments on the secretion of urine by the frog's kidney, which he resumed on his return to physiology in later years. With Beddard also he effected a useful revision of then current views as to the meaning of the sequelæ of partial nephrectomy.

Bainbridge left Guy's in 1907, and, wandering for some years yet further from physiology, was responsible, at the Lister Institute, for valuable contributions to the study and classification of the paratyphoid and food-poisoning group of bacilli. This work formed later the basis of his Milroy Lectures to the Royal College of Physicians.

It would seem that, up to this period, Bainbridge had so divided his aims and his interests that onlookers found it difficult to place him. The few who knew him intimately felt that his worth and ability had yet to win a full and general appreciation. When the intermittent manner of its accomplishment is remembered, it appears that his output in physiology was already remarkable; but he had never yet been in a position to regard it as his life-work, and his sound contributions to other branches of medical science seemed, with many, to weaken rather than strengthen his claim and his promise as a physiologist.

It was not till 1911 that his election to the Chair of Physiology of Durham University, in Newcastle, enabled Bainbridge at length to devote himself whole-heartedly to the line of work which most truly held his interest, and for which he felt himself best fitted by early training and natural aptitude. His department soon attained a high standard of efficiency in the training of students, and he resumed, with the late J. A. Menzies, his experiments on the frog's kidney. Later, he entered upon the series of investigations on the adjustment of the heart-beat to the demands of muscular exercise, which will probably rank as his most important and permanent contribution to Science. With Menzies also he wrote what has become one of the most popular and useful of the shorter text-books of physiology for medical students.

When war broke out in 1914 Bainbridge took a commission in the R.A.M.C., and doubled the duties of his Newcastle Chair with those of Medical Officer at a neighbouring military hospital. In 1915 he was appointed to the Chair of Physiology at his old hospital, St. Bartholomew's, in London, and combined the duties of this new Chair with those of an officer in the Anti-gas Service, experimenting at Millbank, or touring the country as a training-officer in defensive measures. Though he was active, and even rather athletic by inclination, his constitution was never really robust, and was not fitted for this unremitting overwork. The growing demands of his teaching necessitated the resignation of his commission, and, during the period of moderate health remaining to him, he found time to complete a monograph on "The Physiology of Muscular Exercise," which was published at the end of 1919, and was received with general appreciation by physiologists and others interested in its subject. It was, indeed, in many ways a model of what such a survey of knowledge should be, and the best proof which Bainbridge has left of one aspect of his ability. The presentation was clear and logical, and it showed a sound instinct for essentials, in a subject of which the main outlines have too often been obscured by controversy concerning details. The note of personal contact with the problem was clearly heard, but not unduly emphasised, and the monograph was generally recognised as a sound and scholarly achievement.

To those who had known Bainbridge long, it seemed that he changed far less than most men do. In later years the circle of his friendship widened greatly, but the associations formed in the early days always had first place in his regard. Similarly, his experience and his influence widened; but those who had the privilege of intimacy with him found that his tastes and convictions, his fundamental attitude to life, changed remarkably little from those of his student-days. It may be that a rather prematurely cautious and reticent habit of mind had hampered his earlier career.

His stature was small, his manner quiet and unimpressive, and he had no great natural gift of vividness or eloquence in public speaking, though he became a clear and effective lecturer to students. These things, with his hesitation in committing himself definitely to the work for which he was best adapted, rather delayed the recognition which was only beginning to come to him in proper measure when he died. With health and opportunity, he would have carried much farther the work that he had begun.

Bainbridge married in 1905, and, to those who knew him well, the thought of his wife's brave and buoyant comradeship, through times of hesitation and disappointment, of success and recognition, and, finally, of stubborn fight against ill-health, is inseparable from his memory. His widow, his sisters, and his young daughter will have, in their sad loss, the sympathy of all who knew him, and especially of that smaller group, who, through years of intimacy, had come to know and to prize the steadfast affection, the quiet but unwavering loyalty to ideals and convictions, which were outstanding features of a fine character.

H. H. D.

AUGUSTUS DÉSIRÉ WALLER, 1856–1922.

It was with the greatest surprise and deepest regret that his numerous friends heard of the sudden death of Prof. Waller a few weeks ago. He was ill for only twelve days; he had a slight stroke, from which his medical attendants thought he would fully recover, but other and severer hæmorrhages followed and he passed quietly away on March 11th.

He was born on July 12th, 1856, so that at his death he was in his sixty-sixth year. He was in full vigour and no one would have expected from his energy, both mental and bodily, that the end would come so soon.

He was the only child of Dr. Augustus Volney Waller, F.R.S., and like his father he became famous in physiology. His father's name in adjectival form is familiar throughout the world, and his discovery of what is now called "Wallerian degeneration" stands out as one of the most important milestones in physiological history. His son was very jealous of the reputation of his father, and I remember one of the few occasions on which I have seen him roused to anger was when he thought his father's work had been misrepresented. He dedicated his 'Introduction to Human Physiology' to his father's memory, summarising the latter's work in the words:—

Emigration of leucocytes, 1846.
Degeneration and regeneration of nerve, 1856.
Cilio-spinal region, 1851.
Vaso-constrictor action of sympathetic, 1853.

One of his sons still carries on the physiological tradition, Dr. William Waller being one of the junior staff at the University of Liverpool.

The second Waller, whose loss we have now to deplore, was born in Paris, where at the time his father was pursuing his work, and he received his early education at the Collège de Genève. This early training had considerable influence subsequently. He wrote and spoke French fluently, and he usually communicated the results of his research work to learned societies in both countries. Some of his mannerisms, his expressive and eloquent gestures, were doubtless to be traced to the same source.

In 1870 his father died and he went with his mother to Aberdeen, where, after graduating M.B., C.M., in 1878, he finally took his M.D. in 1881. He studied also in Edinburgh, but soon migrated to London, and worked at University College under the then Professor of Physiology, Dr. (afterwards Sir John) Burdon Sanderson. He received grants from the British Medical Association to assist him in his investigations, and in 1884 became Research Scholar under the same body.

His first independent appointment as a teacher was that of Lecturer on Physiology at the London School of Medicine for Women, where he met the lady who became his wife and life-long companion and helper. He then obtained a similar post at St. Mary's Hospital, and finally, about twenty years ago, he was appointed Honorary Director of the Physiological Laboratory at the University of London, with the title of Professor. With characteristic keenness he had explored the buildings at South Kensington in which the University had just been housed, saw the possibilities of using profitably a suite of disused rooms, and, with the help of friends, secured them for the useful purpose to which, through his efforts, they were ultimately applied.

Waller's name became known to the physiologists chiefly through his work on the electrical phenomena of the nervous system and of the heart. In this work his ingenuity in the devising of experiments and apparatus came to the fore. In 1913, he summarised his many years' work on the heart in the Oliver-Sharpey lectures given before the Royal College of Physicians. I cannot do better than quote from a letter by Sir Thomas Lewis, F.R.S.,[*] the foremost of present day electro-cardiographers, regarding the value of this branch of research. He wrote:—

"May I add a few words of tribute to the memory of Prof. Waller, whose death will be much regretted by both physiologists and physicians in this country and in many other lands. He was a man of unusually keen intellect, and has been for many years a notable figure in British physiology. His brilliant powers of exposition will long render his demonstrations at the Physiological Society memorable. His early work on electro-physiology was extensive, thorough, and is well known. He was the first to show that the currents set up by the beating of the human heart can be recorded; he was the first to obtain a human electro-cardiogram; this has been the main though by no means his sole contribution to the science of experimental medicine. The discovery long preceded the introduction of the string galvanometer, and was the more remarkable in that it was accomplished in the eighties."

The electrical phenomena in other living structures also attracted his attention; he published numerous papers on the currents found in the retina, nerves, muscles, skin, etc., and also in plants. They are summarised in his book "Signs of Life from the Electrical Aspect," published in 1903. The high estimation in which his work was held was shown by his election as F.R.S. at the comparatively early age of 36, in 1892.

During his investigation of nerve and muscle, he made observations on the effects of anæsthetic vapours and gases on their electrical responses, and thus he became interested in clinical anæsthesia, and in lectures, demonstrations and discussions insisted on the necessity of accurate dosage in the administration of these dangerous means of alleviating suffering, especially in reference to chloroform. He invented an apparatus for controlling the percentage of the anæsthetic in the air a patient breathed, for he was convinced that deaths under chloroform could be prevented with proper care. In 1901, a Committee was established by the British Medical Association to go thoroughly into the matter, and Waller became one of its most earnest members, and was at one time its Chairman. The report which was published ten years later is a most valuable document, and formed another example of how Waller's academic work was fruitful from the practical standpoint.

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[*] 'Brit. Med. Journ.,' 1922, vol. i, p. 459.

During the last few years of his life, he became interested in three new subjects, and threw himself with his usual enthusiasm into all of them. His laboratory at one time was, or seemed to be, wholly devoted to one of these; at another time, it was one or other of the remaining two. This was not only the case at the South Kensington laboratory, but the same fervour was manifested at his private but well known laboratory at his home in Grove End Road. The old roomy studio (for the house formerly belonged to a well-known artist) was transformed not only into a laboratory, but became the principal living room of the professor and his family, where they received their friends scientific and otherwise. It opened into a spacious garden which also was a great recreation to the workers. The large table in the middle of the room was crowded with electrical and other apparatus, when by an ingenious arrangement of pulleys, the top was suddenly hoisted ceiling-wards, and a full-sized billiard table was revealed. Waller was as keen on games as he was on work, and billiards were not the least of his accomplishments. When he first took to driving a motor car, all his energy seemed devoted to mastering the intricacies of its mechanism and management. Another of the many other interests of his many-sided life was his fondness for animals, and especially for bull-dogs. The ancestor of several generations of these was Jimmy who became well known as his constant companion in the car and in the laboratory. He was the faithful guardian of the car when his master left it standing, his fierce countenance being sufficient to repel intruders in spite of his gentle nature. Jimmy appeared at several Royal Society Soirées, with his paws in basins of salt solution which were connected to a galvanometer or electrometer in order to demonstrate the accompanying electrical changes of his heart's activity to an admiring audience. The Home Secretary of that day, Mr. Herbert, now Lord Gladstone, had to explain to anti-vivisectionist members of the House of Commons that this was not a brutal experiment, and that Jimmy suffered as much or as little pain as a child paddling in the sea.

But these are digressions. I had begun to speak of the subjects which interested Waller in later years. One of these which only needs a passing mention was of a polemical nature, and related to certain movements which with the aid of high magnification can be shown to occur in plants. Waller attributed these not to growth, but to mere turgescence such as occurs when many substances are placed in water.

The other two topics to which he devoted himself were of a more serious nature. One of these was the investigation of the so-called "emotive response," and the other the measurement of the cost of muscular work by estimation of the carbonic acid exhaled.

Both were pursued with characteristic intensity; his friends inveigled into the laboratory had to submit to be put "on the wires" in order that the change in the resistance of their skin which occurs under various emotions might be measured and recorded; one of the many interesting outcomes of this work was that most people reacted to the threat of an injury, such as a burn, much more strongly than to actual pain. During the air raids he had his wife and others "on the wires" and noticed a corresponding effect. The investigations on muscular work were carried out on himself, his friends, soldiers, colliers, bootmakers, printers and many other classes. He found the severity of the work and the output of CO_2 were parallel. His method has been criticised, as no account was taken of the oxygen usage, but Waller never claimed absolute accuracy; he regarded his "short method" for testing the cost of work as a practical means to an end which can be accomplished only with accuracy by much longer and more complicated methods. It can be carried out while the work is in actual progress. It was his intention to have compared the two methods in a parallel series of experiments had his life been spared, but in criticising his critics showed that their longer methods did not always give better results than his own.

Waller's contributions to the literature of his subject were numerous, and in addition to the books already mentioned, they were mainly published in the 'Proceedings' and 'Transactions' of our Society, and in the 'Journal of Physiology.' His academic distinctions were also numerous. In 1889 he was made a Lauréat of the Institute of France; he received the Aldini prize from the Royal Academy of Science of the Institute of Bologna. He was a corresponding member of many foreign learned societies and academies, and an honorary member of the Council of the University of Tomsk.

Prof. Waller married Alice Mary, daughter of the late Mr. George Palmer, M.P. for Reading. It was an ideal union. Mrs. Waller shared in all his work, and he was a devoted husband; her recent illness caused him to relinquish his other work; he took a room near the nursing home where she was in order to be with her constantly; later, when she returned home he used to carry her to and from her room; his anxiety about her was most intense.

He was an equally devoted father; he had three sons, and two daughters, all of whom survive him except the youngest daughter, whose tragic death from drowning seemed to leave a permanent mark of sorrow in his character. He was no doubt a physiologist first, but in this imperfect survey of his life's work I have endeavoured to show that there were other sides to his personality. He passed through many turmoils, of which the last (the attempt to close the University laboratory while he was in full vigour and it was in full swing of useful work) was by no means the least. He won that victory; he was a good fighter, an ardent and affectionate friend and a great man.

W. D. H.

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George S Brady